

1 1. A nerve regeneration conduit comprising a porous biocompatible support
2 comprising an inner surface and an outer surface, the support being in the form of a roll
3 such that a cross section of the roll approximates a spiral spanning from 8 to 40 rotations,
4 with the outer surface of the support facing outward, relative to the origin of the spiral.

1 2. The nerve regeneration conduit of claim 1, wherein the support has a thickness
2 of 5 to 200 μm .

1 3. The nerve regeneration conduit of claim 1, wherein the support has a thickness
2 of 10 to 100 μm .

1 4. The nerve regeneration conduit of claim 1, wherein the support comprises a
2 biological material.

1 5. The nerve regeneration conduit of claim 4, wherein the biological material is
2 small intestinal submucosa.

1 6. The nerve regeneration conduit of claim 1, wherein the support comprises a
2 synthetic polymer.

1 7. The nerve regeneration conduit of claim 1, wherein the support is
2 bioresorbable.

1 8. The nerve regeneration conduit of claim 6, wherein the synthetic polymer is
2 selected from the group consisting of polyhydroxyalkanoates, e.g., polyhydroxybutyric
3 acid; polyesters, e.g., polyglycolic acid (PGA); copolymers of glycolic acid and lactic
4 acid (PLGA); copolymers of lactic acid and ϵ -aminocaproic acid; polycaprolactones;
5 polydesoxazon (PDS); copolymers of hydroxybutyric acid and hydroxyvaleric acid;
6 polyesters of succinic acid; polylactic acid (PLA); cross-linked hyaluronic acid;
7 poly(organo)phosphazenes; biodegradable polyurethanes; and PGA cross-linked to
8 collagen.

1 9. The nerve regeneration conduit of claim 1, further comprising a layer of cells
2 adhered to the inner surface of the support.

1 10. The nerve regeneration conduit of claim 9, wherein the cells are Schwann
2 cells or olfactory ensheathing glial cells.

1 11. The nerve regeneration conduit of claim 10, wherein the layer contains from
2 15,000 to 165,000 Schwann cells per millimeter of conduit length.

1 12. The nerve regeneration conduit of claim 11, wherein the layer contains from
2 20,000 to 40,000 Schwann cells per millimeter of conduit length.

1 13. The nerve regeneration conduit of claim 9, further comprising a layer of
2 extracellular matrix material on the support.

1 14. The nerve regeneration conduit of claim 1, further comprising a hydrogel
2 layer.

1 15. The nerve regeneration conduit of claim 14, wherein the hydrogel layer has a
2 thickness of 5 to 120 μm .

1 16. The nerve regeneration conduit of claim 15, wherein the hydrogel layer has a
2 thickness of 10 to 50 μm .

1 17. The nerve regeneration conduit of claim 14, wherein the hydrogel layer
2 comprises a polymer selected from the group consisting of fibrin glues, Pluronic[®],
3 polyethylene glycol (PEG) hydrogels, agarose gels, PolyHEMA (poly 2-
4 hydroxyethylmethacrylate) hydrogels, PHPMA (poly N-(2-hydroxypropyl)
5 methacrylamide) hydrogels, collagen gels, Matrigel[®], chitosan gels, gel mixtures (e.g., of
6 collagen, laminin, fibronectin), alginate gels, and collagen-glycosaminoglycan gels.

1 18. The nerve regeneration conduit of claim 1, further comprising a multiplicity
2 of microspheres.

1 19. The nerve regeneration conduit of claim 18, wherein the microspheres are
2 immobilized in a hydrogel layer.

1 20. The nerve regeneration conduit of claim 14, wherein the hydrogel layer
2 comprises a neurotrophic agent.

1 21. The nerve regeneration conduit of claim 18, wherein the microspheres
2 comprise a neurotrophic agent.

1 22. The nerve regeneration conduit of claim 18, wherein the microspheres have a
2 diameter of 1 to 150 μm .

1 23. The nerve regeneration conduit of claim 18, wherein the microspheres
2 comprise a material selected from the group consisting of a polyhydroxyalkanoate, a
3 polyester, a copolymer of glycolic acid and lactic acid (PLGA), a copolymer of lactic
4 acid and ϵ -aminocaproic acid, a polycaprolactones, polydesoxazon (PDS), a copolymer of
5 hydroxybutyric acid and hydroxyvaleric acid, a polyester of succinic acid; and cross-
6 linked hyaluronic acid.

1 24. The nerve regeneration conduit of claim 23, wherein the microspheres
2 comprise PLGA having an average molecular weight of 25 kD to 130 kD.

1 25. The nerve regeneration conduit of claim 24, wherein the lactic acid:glycolic
2 acid ratio is approximately 85:15.

1 26. The nerve regeneration conduit of claim 18, wherein the microspheres are
2 arranged in a pattern to facilitate creation of a neurotrophic agent concentration gradient.

1 27. The nerve regeneration conduit of claim 26, wherein the gradient is radial.

1 28. The nerve regeneration conduit of claim 26, wherein the gradient is axial.

1 29. The nerve regeneration conduit of claim 20 or 21, wherein the neurotrophic
2 agent is selected from the group consisting of FK506, α FGF, β FGF, 4-methylcatechol,
3 NGF, BDNF, CNTF, MNGF, NT-3, GDNF, NT-4/5, CM101, inosine, spermine,
4 spermidine, HSP-27, IGF-I, IGF-II, PDGF, ARIA, LIF, VIP, GGF, IL-1, and MS-430.

1 30. The nerve regeneration conduit of claim 20, wherein the hydrogel layer
2 comprises two or more neurotrophic agents.

1 31. The nerve regeneration conduit of claim 21, wherein the microspheres
2 comprise two or more neurotrophic agents.

1 32. The nerve regeneration conduit of claim 31, wherein the neurotrophic agents
2 are in separate microspheres.

1 33. The nerve regeneration conduit of claim 31, wherein two or more
2 neurotrophic agents are in a single microsphere.

1 34. A method of manufacturing a nerve regeneration conduit, the method
2 comprising providing a porous biocompatible support comprising an inner surface and an
3 outer surface; and forming the support into a roll such that a cross section of the roll
4 approximates a spiral spanning from 8 to 40 rotations, with the outer surface of the
5 support facing outward, relative to the origin of the spiral.

1 35. The method of claim 34, further comprising culturing a layer of cells on the
2 support prior to forming the support into the roll.

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1 36. The method of claim 34, further comprising depositing a hydrogel layer on
2 the support before forming the support into a roll.

1 37. The method of claim 34, further comprising incorporating a multiplicity of
2 microspheres into the conduit.

1 38. The method of claim 37, wherein the microspheres comprise a neurotrophic
2 agent.

1 39. A method of facilitating regeneration of a transected nerve across a nerve gap
2 defined by a proximal end of the transected nerve and a distal end of the transected nerve,
3 the method comprising coapting the proximal end of the transected nerve to a first end of
4 the conduit of claim 1, and coapting the distal end of the transected nerve to a second end
5 of the conduit.

1 40. A method of facilitating regeneration of a crushed nerve, the method
2 comprising providing a porous biocompatible support comprising an inner surface and an
3 outer surface; culturing a layer of cells on the support; and rolling the support around the
4 crushed nerve.

1 41. The method of claim 40, further comprising depositing a hydrogel layer on
2 the support before rolling the support around the crushed nerve.

1 42. The method of claim 40, further comprising incorporating a multiplicity of
2 neurotrophic agent-laden microspheres into the conduit.

1 43. The nerve regenerating conduit of claim 14, wherein the hydrogel further
2 comprises cells.

1 44. The nerve regenerating conduit of claim 1, wherein the support further
comprises spacer members extending from the inner surface of the support.

1 45. The nerve regenerating conduit of claim 1, wherein the support is loaded with
2 one or more neurotrophins.

1 46. The nerve regenerating conduit of claim 45, wherein the one or more
2 neurotrophins are distributed in a gradient in the support.